What is claimed is:

1. A tunable phase shifter comprising;

a waveguide;

a finline substrate positioned within the waveguide;

a tunable dielectric layer positioned on the finline substrate;

a first conductor positioned on the tunable dielectric layer; and

a second conductor positioned on the tunable dielectric layer, the first and second conductors being separated to form a gap.

2. A tunable phase shifter according to claim 1, wherein:

the gap extends from a first end of the tunable dielectric layer to a second end of the tunable dielectric layer;

the gap includes a first end, a center portion and a second end; and

the gap includes exponentially tapered portions adjacent to said first and second ends.

3. A tunable phase shifter according to claim 2, wherein the gap has a minimum width ranging from 2 micron to 50 micron.

4. A tunable phase shifter according to claim 1, further comprising:

a voltage source for applying a control voltage between the first conductor and the second conductor.

5. A tunable phase shifter according to claim 1, wherein the second conductor forms an RF ground.

6. A tunable phase shifter according to claim 1, wherein the second conductor comprises:

an RF choke.

7. A tunable phase shifter according to claim 1, wherein the waveguide includes first and second sections, and the tunable phase shifter further comprises:

a first conductive plate positioned between the first and second sections of the waveguide; and

a second conductive plate positioned between the first and second sections of the waveguide, the first conductive plate being insulated from the waveguide and the second conductive plate being electrically connected to the waveguide.

8. A tunable phase shifter according to claim 7, further comprising an impedance matching section formed by a gap between the first and second conductive plates.

9. A tunable phase shifter according to claim 8, wherein the impedance matching section comprises:

an exponentially tapered gap between the first and second conductive plates.

10. A tunable phase shifter according to claim 1, wherein:

the first conductor is insulated from the waveguide and includes an RF ground; and

the second conductor is electrically connected to the waveguide.

11. A tunable phase shifter according to claim 10, further comprising an impedance matching section formed by a gap between the first and second conductors.

12. A tunable phase shifter according to claim 11, wherein the impedance matching section comprises:

an exponentially tapered gap between the first and second conductors.

13. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises a material selected from the group of:

barium strontium titanate, barium calcium titanate, lead zirconium titanate, lead lanthanum zirconium titanate, lead titanate, barium calcium zirconium titanate, sodium nitrate, $KNbO_3$, $LiNbO_3$, $LiTaO_3$, $PbNb_2O_6$, $PbTa_2O_6$, $KSr(NbO_3)$, $NaBa_2(NbO_3)_5$, KH_2PO_4, and combinations thereof.

14. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises a barium strontium titanate (BSTO) composite selected from the group of:

BSTO-MgO, BSTO-$MgAl_2O_4$, BSTO-$CaTiO_3$, BSTO-$MgTiO_3$, BSTO-$MgSrZrTiO_6$, and combinations thereof.

15. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises a material selected from the group of:

Mg_2SiO_4, $CaSiO_3$, $BaSiO_3$, $SrSiO_3$, Na_2SiO_3, $NaSiO_3$-$5H_2O$, $LiAlSiO_4$, Li_2SiO_3, Li_4SiO_4, $Al_2Si_2O_7$, $ZrSiO_4$, $KAlSi_3O_8$, $NaAlSi_3O_8$, $CaAl_2Si_2O_8$, $CaMgSi_2O_6$, $BaTiSi_3O_9$ and Zn_2SiO_4.

16. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises:

an electronically tunable dielectric phase and at least two metal oxide phases.

17. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer has a dielectric constant at zero bias voltage ranging from 30 to 2000.

18. A tunable phase shifter according to claim 1, wherein the a finline substrate comprises:

a low loss, low dielectric material.